LANDSAT DATA CONTINUITY MISSION

MISSION OPERATIONS ELEMENT

STATEMENT OF WORK

August 2007

Goddard Space Flight Center
Greenbelt, Maryland

CM FOREWORD

This document is a Landsat Data Continuity Mission (LDCM) Project Configuration Management (CM)-controlled document. Changes to this document require prior approval of the applicable Configuration Control Board (CCB) Chairperson or designee. Proposed changes shall be submitted to the LDCM CM Office (CMO), along with supportive material justifying the proposed change. Changes to this document will be made by complete revision.

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LDCM PROJECT
DOCUMENT CHANGE RECORD

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REV LEVEL	DESCRIPTION OF CHANGE	APPROVED BY	DATE APPROVED

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Introduction

The Landsat Data Continuity Mission (LDCM) is the successor mission to Landsat 7. Landsat satellites have continuously acquired multi-spectral images of the global land surface since the launch of Landsat 1 in 1972. The Landsat data archive constitutes the longest record of the land surface as viewed from space. The LDCM mission objective is to extend the ability to detect and quantitatively characterize changes on the global land surface at a scale where natural and man-made causes of change can be detected and differentiated.

Scope

This Statement of Work (SOW) defines the minimum effort required of the Contractor that shall include but is not limited to the design, engineering analyses, development, integration, test,

evaluation, delivery, and support for the LDCM primary and backup Mission Operations Elements (MOE).

The primary functions of the MOE include command and control, mission planning and scheduling, trending and analysis, flight dynamics, observatory health and safety monitoring, on-board storage management and flight software management. The MOE will be delivered to a Mission Operations Center (MOC) at a Government provided facility at the NASA Goddard Space Flight Center in Greenbelt, Maryland. The backup MOE will be delivered to a Government-provided Back-Up MOC (bMOC) Facility at the U.S. Geological Survey (USGS) Center for Environmental Resources and Observation Science (EROS) in Sioux Falls, South Dakota.

The Government is responsible for providing the observatory and the Ground System, other than the MOE, for mission systems integration, and mission operations. The Contractor shall support the MOE-related portions of the Government's ground system integration and mission system integration efforts. LDCM Mission Operations during the Launch and Early Orbit (LEO), observatory check-out, and commissioning phases will be performed by a Government-provided Flight Operations Team (FOT) and will be conducted from the NASA GSFC MOC. Following commissioning and successful acceptance of the LDCM, the primary MOC role will transition to the USGS EROS location, where mission operations will be performed through decommissioning. At this time a backup MOC at a TBD location will serve as the location for contingency and/or temporary observatory mission operations in the event the primary MOC is unavailable.

This Statement of Work requires delivery of the Mission Operations Elements and backup Mission Operations Element which shall meet the requirements of the LDCM Mission Operations Element Requirements Document (MOE-RD). This Statement of Work also requires installation of the MOE in the Government Mission Operations Center (MOC) and installation of the backup MOE in the Government Back-up MOC. Unless otherwise specified, all references to the MOE in this SOW shall apply equally to the backup MOE.

This Statement of Work requires delivery of all contract deliverables associated with the MOE development. The MOE shall meet the requirements of all contractual documents.

Provisional acceptance of the MOE shall take place prior to the launch of the LDCM, following the verification of all requirements, successful completion of all MOE testing, and the successful completion of the LDCM Operations Readiness Review. Final acceptance of the MOE shall take place during on orbit commissioning phase of the LDCM observatory, following successful verification of the post-launch MOE delivery/release.

Definitions

The following definitions apply to this document:

Shall – Compliance by the Contractor is mandatory. Any deviations from these contractually imposed mandatory requirements require the approval of the Contracting Officer.

May – At the discretion of the Contractor or Government.

Will – Designates the intent of the Government. Unless required by other contract provisions, noncompliance with the *will* requirements does not require approval of the contracting officer and does not require documented technical substantiation.

Engineering Peer Review (EPR) – a meeting with approximately 2 to 5 Government representatives to discuss specific details of a given subsystem design or performance, subsystem test results, mode performance, etc. EPRs typically take place at the contractor's facility and take a day. EPRs are the principal means to familiarize review team members prior to a major design review. EPR actions are informally tracked by the EPR organizer.

Technical Interchange Meeting (TIM) – a meeting with approximately 5 to 10 Government representatives to discuss a system process or feature. For example, to reach understanding of an operation or analysis, presentation of test results, discuss planned interface changes, plan for an upcoming test, etc. TIMs typically are held at the contractor's facility and run no more than two days. Actions are informally tracked by the TIM organizer.

Design Review (DR) – Design reviews are major milestones in the implementation where information is formally presented to a panel of Government experts and external reviewers. DRs can involve up to 30 Government representatives and run up to four days. Action items are formally logged and tracked by the Project Office.

Applicable Documents

The documents listed in this section apply directly to the performance of the LDCM Mission Operations Element (MOE) Contract. These documents establish detailed specifications, requirements, and interface information necessary for the performance of the contract. Unless otherwise specified, the document version listed herein shall apply. In case of conflicting requirements, the order of precedence of documents not specifically called out in the Contract is: this Statement of Work, and then the Contract Data Requirements List.

a. LDCM Mission Operations Element Requirements Document: Document Number 427-09-03.

b. LDCM MOE Contract Data Requirements List: Document Number 427-09-02.

c. LDCM Acronym List and Lexicon: Document Number 427-02-06.

d. Criteria for Flight Project Critical Milestone Reviews, GSFC-STD-1001, February 2005

e. NPR 2810.1, Security of Information Technology

f. NPR 7150.2, NASA Software Engineering Requirements

g. Committee on National Security Systems (CNNS) Policy No. 12

h. NASA Policy Directive 8010.2, Use of the SI (Metric) System of Measurement in NASA Programs

i. GPR 1060.2, Management Review and Reporting for Programs and Projects

j. GPR 8700.4, Integrated Independent Reviews

k. NPR 5100.4, Federal Acquisition Regulation Supplement

l. NPR 8000.4, Risk Management Procedural Requirements

m. NPR 8715.3, NASA Safety Manual

n. GPR 7120.4, Risk Management

Reference Documents

a. LDCM Operations Concept, 427-02-02

b. Landsat Worldwide Reference System-2 (WRS-2) Definition, January 4, 2007, 427-02-07.

c. NASA NPR 7120.5D NASA Space Flight Program and Project Management Requirements

Work to be Performed

This section, along with the Contract Data Requirements List (CDRL) document 427-09-01, describes the specific work to be accomplished by the MOE Contractor. In accordance with the requirements of this document, the contract, all associated requirements documents, and the other attachments and applicable documents to this contract, the Contractor shall provide the personnel, materials, equipment, and facilities necessary for the successful and on-time implementation of the design, analysis, development, integration, test, engineering data analyses, qualification, delivery, installation, and sustaining engineering of the LDCM MOE.

The Contractor shall deliver and install a primary and backup MOE that are fully tested and have demonstrated compliant and reliable end-to-end operation in accordance with the requirements of this contract. The Contractor shall deliver and install a primary and backup MOE that are ready for operation. The primary and backup MOE shall be delivered to and installed in the MOC and backup MOC, respectively.

1 Management

1.1 Project Management

The Contractor shall maintain a project office to manage the technical activities and resources of the MOE project. The Contractor shall appoint a dedicated Project Manager to direct and manage the MOE project. The Contractor's Project Manager shall have responsibility for the overall technical performance, resource management, and schedule management of the contractual effort and all subcontracts. The Contractor's designated Project Manager shall report to a level of company management appropriate to ensure prompt resolution of all problems. For costing purposes, the duration of Project Management shall be until post-launch final acceptance. Project Management activities after final acceptance of the MOE shall be as specified within sections 7.0.

The Contractor shall prepare a Project Management Plan, an Organizational Conflict of Interest Plan, and a Final Report in accordance with CDRL PM-11, CDRL PM-13, and CDRL PM-4, respectively.

Government Oversight

The Contractor shall open to Government attendance all Contractor and subcontractor internal data, reviews, audits, meetings and other activities within the scope of the contract. For access and insight activity, "Government" includes Government personnel and Government contractor personnel. The Contractor shall allow and enable the use of Non-Disclosure Agreements with Government contractors where appropriate. The Contractor shall notify the Contracting Officer, the Government Resident Office and the Contracting Officer's Technical Representative (COTR) of meetings, reviews or tests in sufficient time (nominally at least 10 working days) to permit meaningful Government participation.

Government Visitor Support

The Contractor shall provide facilities to support two visiting Government representatives at the MOE development site, including office space telephones, and network access to the Contractor's electronic database, from contract award through MOE integration to the MOC and bMOC facilities and LDCM Ground System. The Contractor shall provide within this office space high-speed (broadband) internet access and access to an ISP (Internet Service Provider) outside the Contractor's facility to allow for access to the GSFC and USGS networks. Government representatives shall include government employees or technical support contractors, including but not limited to project management, technical and engineering staff, an LDCM Flight Operations Team members.

Access to Controlled Facilities

The Contractor shall obtain all required access authorizations and submit any paperwork required for the Contractor to access Government controlled facilities, such as the Mission Operations Center. The Contractor shall allow access by the Government to all Contractor facilities used by MOE.

Risk Management

The Contractor shall establish and maintain a comprehensive risk management program. The Contractor shall generate a top risk report that is presented and reviewed at all Monthly Project Status Reviews (MPSRs). The Contractor shall provide an estimate of the potential cost impact if risks were to become real problems. The Contractor shall invite the Government to attend Contractor Risk Management Board meetings. The Contractor shall develop and implement a project-specific Risk Management Plan (RMP), in accordance with CDRL PM-12, as a means to anticipate, mitigate and control risks and to focus project resources to ensure success of the project.

The primary activities of the Contractor Continuous Risk Management (CRM) process are:

a. Search for, locate, identify, and document reliability and quality risks before they become problems.
b. Evaluate, classify, and prioritize all identified reliability and quality risks.
c. Develop and implement risk mitigation strategies, actions, and tasks and assign appropriate resources.
d. Track risk being mitigated; capture risk attributes and mitigation information by collecting data; establish performance metrics; and examine trends, deviations, and anomalies.
e. Control risks by performing: risk close-out, re-planning, contingency planning, or continued tracking and execution of the current plan.
f. Communicate and document (via the risk recording, reporting, and monitoring system) risk information to ensure it is conveyed between all levels of the project.
g. Report on outstanding risk items at all management and design reviews.

The GSFC Project Office and the MOE Contractor will agree on what level of detail is appropriate for each review.

The Contractor shall document the project-specific implementation of the CRM process in a RMP in accordance with CDRL PM-12. Preparation of the RMP is a requirement established by NPR 7120.5 and includes the content shown in NPR 8000.4, "Risk Management Procedural Requirements."

The Contractor shall document and report all identified risks in accordance with the project's RMP. The Contractor shall address identified risk areas at project status reviews and at Integrated Independent Reviews (GPR 8700.4). The Contractor shall make risk status available to all members of the project team for review. Although not all risks will be fully mitigated, the Contractor shall address all risks with mitigation and acceptance strategies agreed upon at appropriate mission reviews.

The Contractor shall maintain a Risk List throughout the project life cycle, along with programmatic impacts. The list should indicate which risks have the highest probability, which have the highest consequences, and which risks represent the greatest risk to mission success. The list should also identify actions being taken to address each specific risk. The Contractor shall maintain the Risk List under configuration control.

For each primary risk (those having both high probability and high impact/severity), the Contractor shall prepare and maintain the following in the risk sections of the Project Plans:

- Description of the risk, including primary causes and contributors, current mitigation strategy, and information collected for tracking purposes.
- Primary consequences should the undesired event occur.
- Estimate of the probability of occurrence (qualitative or quantitative) together with the uncertainty of the estimate and the effectiveness of any implemented risk mitigation measures.
- Potential additional risk mitigation measures, which shall include a comparison of the cost of risk mitigation versus the cost of occurrence multiplied by the probability of occurrence.
- Characterization of a primary risk as "acceptable" shall be supported by a rationale (with the concurrence of the GSFC LDCM Project Office) that all reasonable mitigation options (within cost, schedule, and technical constraints) have been instituted.

Software Management

The Contractor shall document in the Software Development and Management Plan (SDMP) document, in accordance with CDRL MO-9, the software management approaches and processes for software analysis, design, development, documentation, version control, test, validation, risk management, metric collection, and assurance of all software products. The Contractor shall adhere to the SDMP.

Reviews and Meetings

The reviews listed in this section shall not be considered a comprehensive set of reviews for the Contractor's program. Additional reviews that the Contractor deems necessary to successfully execute the program may be conducted at the Contractor's discretion. The Contractor shall notify the Government at least 10 working days in advance of lower level Contractor subsystem reviews to allow the Government time to attend the review as part of its insight activities.

A. Milestone Reviews

All milestone reviews will be convened and review boards appointed and chaired by the Government. The Contractor shall demonstrate compliance with the review success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews, as applicable to the MOE. The Contractor shall respond as required to action items assigned by the Government. The Contractor shall work with the Government project and review team an additional _-1 day following all reviews to discuss and address issues raised and actions assigned at the reviews. The Government will convene a delta review if the success criteria for a review are not met to the Government's satisfaction. The Contractor shall prepare and present their portion of these reviews, as appropriate.

A.1 MOE Reviews

The Contractor shall host, prepare and present the MOE Level independent milestone reviews and provide a review packages in accordance with the stated CDRLs:

- MOE System Requirements Review (M-SRR), CDRL RE-1
- MOE Preliminary Design Review (M- PDR), CDRL RE-2
- MOE Critical Design Review (M-CDR), CDRL RE-3
- MOE Pre-Ship Review (M-PSR), CDRL RE-5

The Contractor shall assume that each MOE review requires one day to complete. The Contractor shall assume that the M-SRR and M-PDR are conducted as a combined 2-day review. For planning purposes the Contractor shall assume the following dates for these reviews:

Review	**Date**
M-SRR / M-PDR	July 2008
M-CDR	October 2008
M-PSR	June 2009

MOE Reviews will be less formal than Ground System, Mission, Spacecraft, and Instrument independent reviews, and will be working-level in nature. The Contractor shall coordinate the review agenda and content with the Government. The Contractor shall respond to action items as requested by the Government. The Government will convene a delta review if the success criteria for a review are not met to the Government's satisfaction. The Contractor shall host these delta reviews, and prepare and present these reviews. For proposal purposes, the Contractor shall assume one delta review will be required during the contract duration.

A.2 Ground System Reviews

The Contractor shall prepare and present the Mission Operations Element (MOE) portion of the Ground System Reviews in accordance with the CDRL RE-6:

- Ground System Preliminary Design Review (GS-PDR)
- Ground System Critical Design Review (GS-CDR)

The Government will host and will also present material at Ground System reviews. The Contractor shall support and attend the Ground System reviews planned to be held at the USGS EROS Facility in Sioux Falls, SD. The Contractor shall support and attend Ground System review dry-runs, which will be hosted by the Government. The Contractor shall respond to action items as requested by the Government. The Contractor shall participate in Ground System review dry-runs with the Government approximately three weeks in advance of the review. The Contractor shall assume that each review and each dry-run require two days to complete.

A.3 LDCM Mission Level Reviews

The Contractor shall participate in and support the Government in preparation for the following Mission Level independent milestone reviews:

- Mission Preliminary Design Review (Mission PDR)
- Mission Critical Design Review (Mission CDR)
- System Integration Review (SIR).

The Contractor shall prepare and present a portion of the following Mission Level reviews and provide their portion of the review packages in accordance with CDRL RE-6:

- Mission Operations Review (MOR)
- Flight Operations Review (FOR)
- Operational Readiness Review (ORR)
- On-Orbit Acceptance Review (OAR).

The Government will lead, host and present material at Mission-level reviews. The Contractor shall respond to action items as requested by the Government. The Contractor shall participate in dry runs of all Mission-Level Milestone Reviews with the Government one week in advance of the reviews. The Contractor shall assume that the Mission Level reviews will take four days and that dry runs will take two days. The Contractor shall assume that Mission-level reviews and dry-runs will occur at the NASA Goddard Space Flight Center.

The Contractor shall also support as necessary the following additional Mission-Level Reviews:

- Safety and Mission Success Review (SMSR)
- Flight Readiness Review (FRR)
- Launch Readiness review (LRR)
- Post-Launch Assessment Review (PLAR)
- Critical Event Readiness Review (CERR)

It is expected that these additional reviews require a lesser degree of preparation and participation by the MOE contractor than the other Mission-Level Reviews.

A.4 Instrument Milestone Reviews

The Contractor shall attend and support the LDCM instrument contractor(s) in preparation for the following instrument reviews:

- OLI Instrument Critical Design Review (ICDR)

The Contractor shall present MOE information and other material as appropriate. The Contractor shall assume two days of attendance at each review at the instrument contractor's facility.

A.5 Spacecraft Reviews

The Contractor shall attend and support the Government in preparation for the following spacecraft reviews:

- Spacecraft System Requirements Review (SSRR)
- Spacecraft Preliminary Design Review (SPDR)
- Spacecraft Critical Design Review (SCDR)

The Contractor shall assume three days of attendance at the spacecraft contractor's facility for each review.

A.6 Ground System Element Reviews

The Contractor shall participate in and support the Government at the following Ground System Element reviews:

- Collection and Activity Planning Element Preliminary Design Review, and Critical Design Review
- Landsat Ground Network Element (GNE) Preliminary Design Review, and Critical Design Review
- Infrastructure Element Preliminary Design Review and Critical Design Review

The Contractor shall assume one day for each Ground System Element review at a Government facility.

B. Engineering Peer Reviews (EPR)

The Contractor shall define and implement a set of Engineering Peer Reviews (EPRs) for the subsystems of the Mission Operations Element commensurate with the scope, complexity and acceptable risk of the product. The Contractor shall submit the Peer Review Plan in accordance with CDRL PM-5.

The Contractor shall chair and host EPRs at the Contractor's facilities with Government participation on the review panels. The Contractor shall document EPRs in accordance with

CDRL RE-7, Engineering Peer Review Data Packages. The Contractor shall systematically and comprehensively peer review the product at the individual subsystem level and lower levels, as appropriate. Subsystem and software design reviews are considered to be EPRs and subject to this procedure. The Contractor shall conduct multiple peer reviews, as appropriate, over the lifecycle of each subsystem and component, with content consistent with the evolving design and development. Applicable peer reviews shall be completed prior to and summarized at the corresponding MOE review (e.g. M-CDR). As a minimum, the Contractor shall complete a appropriate set of subsystem or lower-level peer reviews for customized portions of the MOE prior to MOE PDR and again prior to MOE CDR. Successful completion of these reviews and resolution of associated technical issues and actions is considered to be an important aspect of entry criteria in the formal review process.

The Contractor shall also use EPRs for the focused evaluation of concepts, designs, plans and processes associated with combinations of subsystems and system functions that cross traditional subsystem or discipline boundaries.

As a minimum, but not limited to, EPRs shall be conducted to cover the following items:

- Planning and Scheduling, including the interface to CAPE
- Landsat Ground Network Element (GNE) interface
- MOE automation and availability design & implementation, including MOE-bMOE connectivity
- MOE and bMOE Installation within the MOC and bMOC
- MOE-Spacecraft/Observatory testing

The Contractor shall track action items from EPRs and maintain EPR presentation and closure documentation for the duration of the contract.

C. Other Reviews and Meetings

C.1 Scheduled Weekly Telecons

In addition to other informal communications, the Contractor shall participate in a scheduled weekly telecon with the LDCM Project Office to communicate status, issues, and schedule progress and plans of the overall contract effort. The Contractor shall establish the meeting agenda and distribute meeting minutes and other documentation as required. The minimum Contractor attendance shall consist of the Project Manager and Systems Manager or the element technical lead managers. The Contractor shall provide detailed status, description of issues, and schedule for each major element of the contract.

C.2 Monthly Project Status Reviews

The Contractor shall communicate the status of the MOE technical effort, schedule, and resource condition to the LDCM Project on a monthly basis. The Contractor shall develop and deliver a monthly project status review package, in accordance with CDRL PM-1. The monthly project status review package shall include Integrated Master Schedules (IMS) prepared in accordance with CDRL PM-2

. The Contractor shall participate in _-1 day face-to-face monthly project status reviews alternating between the Contractor's site and a Government site. The Contractor shall assume the Government site for MPSR meetings is NASA's Goddard Space Flight Center. The Contractor shall participate in splinter meetings with the Government for one additional _ - 1 day immediately following each monthly project status review.

C.3 Technical Interchange Meetings and Working Groups

The Contractor shall inform the Government at least one week in advance of technical interchange meetings resolving technical issues concerning critical MOE systems or sub-systems. In certain cases TIMs may be combined with monthly status meetings. TIMs shall also include discussion of prioritized development and delivery schedules.

The Contractor shall participate in Government-led working groups. At the time of the writing of this document, planned Government-led working groups likely requiring MOE Contractor participation include Systems Engineering, Integration and Test (I&T), MOE Interfaces, Mission Operations, IT Security, Communications Security (COMSEC), and Space-to-Ground Interface. The Contractor shall assume for planning purposes participation in up to six working groups, each requiring support equivalent to 2 person-days per month.

C.4 Status and Planning Meetings

The Contractor shall notify and allow the Government access to Contractor status and planning meetings, including daily stand-ups and tag-ups.

1.2 Configuration and Data Management

The Contractor shall perform configuration management (CM) in support of the MOE project The Contractor shall develop and deliver the Hardware and Software Configuration Management Plan in accordance with CDRL PM-10. The Contractor shall notify the Government of CCB meetings and allow Government participation at all CCB meetings. The Contractor shall maintain configuration of all MOE deliveries/releases and all other deliverable items throughout all phases of development and test and until final acceptance of the MOE. The Contractor shall perform and document configuration verification as sub-systems are incorporated into higher-level systems and at major Project milestones. The CM system shall have a change classification and impact assessment process that results in Class 1 and Class 2 Configuration Change Requests (CCRs) being forwarded to the LDCM Project in accordance with CDRL SE-1. Class 1 changes are defined as changes that impact mission science and performance requirements, system safety, cost, schedule, single point failures, and external interfaces. All other changes are considered to be Class 2 changes.

The Contractor shall submit for Government consideration a waiver or deviation for any item that is found to be non-compliant with the requirements of the contract Statement of Work (SOW) or the MOE-RD and is not reworked to be compliant, or is not replaced with a compliant item.

The Contractor shall prepare and provide the following configuration control documentation:

- Configuration Control Board (CCB) status shall be reported at the Monthly Project Status Review and in all monthly status packages in accordance with CDRL PM-1
- The Configuration Item Identification List (CIIL) and the Computer Software Configuration Items (CSCIs) in accordance with CDRL SE-8.

Action Item Tracking

The Contractor shall develop and apply a process for capturing and responding to action items assigned by the review boards, at monthly meetings, technical interchange meetings, and working group meetings . Milestone reviews, as defined above, are not complete until actions are complete or a detailed plan for closure is submitted and approved by the Government.

Problem tracking

The Contractor shall develop a closed-loop problem tracking process that includes problem or discrepancy reporting, problem analysis, and corrective action, and closure. The process shall include: a protocol to review past performance to determine the incidence of identical or related discrepancies, an escalation procedure (to inform higher levels of management and the Government) based on mission criticality, and a closeout process for root cause determination, anomaly mitigation, and recurrence control. The Contractor shall provide Government access to the Contractor's problem tracking process, including the ability to remotely view and submit problems (discrepancy reports), submit a recommended priority for action, and review problem status.

Internal Technical Memoranda

The Contractor shall provide all MOE-relevant technical internal memoranda as requested by the Government in accordance with CDRL SE-2, Contractor Generated Internal Technical Information. The correspondence can be informal to preserve timeliness. The Government shall have access to these memoranda on a timely basis via hard copy or the electronic library described below.

Electronic Access

The Contractor shall provide to the Government and Government contractor personnel, for review purposes, access via remote desk top computer to a general purpose MOE-specific electronic library. This library shall contain all completed reports, analyses, requirements documentation, internal technical memoranda, change requests and documentation, CDRLs, and all other MOE-specific documents prepared by the Contractor. Within each library the Contractor shall maintain an index of the material (updated monthly) and a search engine for document access. The non-CDRL material contained in these electronic databases may be in Contractor format. The Contractor shall make the contents of the electronic library remotely downloadable. The Contractor shall include engineering drawings in this library or provide some other storage/retrieval arrangement, at their option.

1.3 Resource Management

The Contractor shall establish, implement, and maintain a comprehensive resource management system for planning, authorizing, and controlling the total resources effort for each task and for providing timely and adequate visibility into manpower and schedule performance. The system shall be consistent with the Contractor's standards.

The Contractor shall implement an Earned Value System (EVS). The Contractor shall provide an Earned Value System Management Plan in accordance with CDRL PM-6. The EVS may be implemented in accordance with the Contractor's standard plans and policies, provided it includes use of NASA Form 533 reports. The Contractor shall provide Financial Reports and Cost Performance Reports to the Government in accordance with CDRLs PM-7 and PM-8 and the contractor's standard policies and procedures. The Contractor shall conduct an Integrated Baseline Review at the Contractor facility and present data in accordance with CDRL RE-8. The Contractor shall obtain approval from the Government prior to changing the EVM baseline.

The Contractor shall establish, implement, and maintain an integrated scheduling system consistent with their corporate procedures and documented in a schedule management plan. The Contractor shall provide and maintain an Integrated Master Schedule in accordance with CDRL PM-2. The Contractor shall obtain approval from the Government prior to changing the IMS baseline.

The Contractor shall provide the necessary resources for monitoring, controlling, executing, and administering the MOE contract and subcontracts to ensure compliance with all contractual requirements.

2 Systems Engineering

2.1 Requirements Management, Analyses, Derivations, and Allocations

The Contractor shall perform systems engineering to support all MOE-related activities during all stages of development. For costing purposes, the duration of Systems Engineering shall be until post-launch final acceptance. Systems Engineering activities after final acceptance of the MOE shall be as specified within sections 7.0.

The systems engineering effort shall include, but is not limited to, requirements management, analyses of technical requirements, functional and performance allocation of derived requirements, traceability, definition and maintenance of all interfaces, MOE design and verification of all defined, allocated, and derived requirements, systems analyses and special studies as required, risk management support, and tradeoff analyses. This shall include but not be limited to the following specific activities:

a. Providing systems engineering technical direction and oversight throughout all phases of the project.
b. Leading and supporting all peer reviews, project milestone, and status reviews as defined in section 1.2, and preparing related documentation.
c. Performing all necessary system studies, trades, and risk assessments necessary to develop the MOE design consistent with CDRL SE-20.
d. Performing all necessary coordination, studies and analyses required to interface the MOE to the LDCM observatory, observatory simulator, and all Government LDCM ground assets, including support to ground system requirements development and mission operations consistent with CDRL SE-20.
e. Performing systems engineering and analysis in support of tests at the MOE level and throughout ground system and mission integration consistent with CDRL SE-20.
f. Supporting system level technical interface meetings, including technical issue resolution, performance verification plan buy-offs, pending configuration change requests (CCRs), CDRL data submission review/approval status, test data review, anomaly resolution activities, and test support planning.

The Contractor shall provide the definition, allocation, derivations, and traceability of system and subsystem requirements, including software requirements, and the verification approach.

The Contractor shall conduct complete analyses and simulations in support of technical requirements compliance demonstrations to fully establish, define, maintain, and control budget allocations for all required performance and design parameters.

Tasks include the following as a minimum:

a. Developing the MOE Operations Concept in accordance with CDRL MO-1
b. Performing requirements management and traceability using a commercial software tool.

c. Flow-down and traceability of MOE-RD requirements to lower-level system and software requirements, and developing the MOE Lower-Level Systems Requirements Document (SRD) in accordance with CDRL MO-3
d. Ensuring that all requirements are forward and backward traceable between system and software requirements and between software requirements, design, and test
e. Functional and performance allocations and derivations.
f. Maintaining and controlling critical MOE technical performance metrics, margins, budgets that are reported at the Monthly Status Reviews.

2.2 Interface Definition and Verification

The Contractor shall meet the interface requirements of the LDCM Mission Operations Element Requirements Document. The Contractor shall develop inputs to the MOE ICDs in accordance with CDRL MO-2. The Government will maintain the ICDs.

2.3 Design and Performance Verification

The Contractor shall design the MOE system to meet the requirements of the Mission Operations Element Requirements Document. The Contractor shall develop and deliver the Specification Tree in accordance with CDRL SE-13. The Contractor shall maintain and manage MOE requirements in an electronic format.

The Contractor shall develop and maintain all necessary plans and procedures to verify that the MOE meets all requirements described in the LDCM Mission Operations Element Requirements Document. The Contractor shall perform MOE requirements verification in accordance with approved plans and procedures. The Contractor shall also perform and document all analyses of the data and information from the design, development, testing, and acceptance of the Contractor's hardware and software which are required to ensure that the MOE will meet its specifications and objectives. These tasks include, but are not limited to the following:

a. Preparing and maintaining the System Performance Verification Plan and Matrix (CDRL SE-6) for use at the software, subsystem, and MOE system level, including the MOE integration with the observatory, observatory simulator, and Government LDCM assets; and for use in interface verification.
b. Performing MOE requirements testing and verification in accordance with the approved System Performance Verification Plan, Matrix, and all other test plans and procedures.
c. Analyzing and making available for inspection the required lower-level design specifications in order to meet higher-level performance requirements. All such analyses shall be identifiable and accessible for Government review.
d. Preparing and maintaining verification test procedures for use at the software, subsystem, and MOE system level
e. Providing systems engineering support to development of installation procedures and interface checkout/testing procedures
f. Providing the necessary effort and support systems for MOE analysis during all levels of testing, interface verification, and during acceptance.

g. Perform the necessary systems engineering tests and analyses to assure that all requirements of this contract are accomplished successfully and on time.
h. Conducting test evaluation and test reporting, and providing MOE Verification Reports compliant with SE-7.
i. Providing a MOE Users Manual in accordance with CDRL MO-15

2.4 Special Studies

The Contractor shall conduct, in addition to the requirements specified in this document and the contract, additional engineering studies, tests, technical analyses, reviews of test results, design modifications, and tasks relating to the development, implementation, and operation of the MOE, as authorized by the Government and in accordance with Contract Clause C.2. Each task will be initiated by written direction from the Government contracting officer. The Government will coordinate with the Contractor to define each task in detail, and establish manpower ceilings, performance schedules, and deliverables.

3 Ground System and Software Assurance

The Contractor shall comply with the LDCM Ground System Mission Assurance Requirements (MAR).

For all MOE software, the Contractor shall demonstrate compliance with the NASA Software Engineering Requirements specified in the NPR 7150.2, including providing all required documentation and deliverables. This document provides the minimal set of requirements established by the Agency for software acquisition, development, maintenance, operations, and management.

The Contractor shall develop, implement, and maintain a comprehensive software assurance program which meets the requirements of the NASA-STD-8739.8. The Contractor shall assume the MOE software assurance classification is Class B. The Contractor shall adhere to the requirements of Sections 6 and 7 of NASA-STD-8739.8, perform all required tasks, and deliver all documents and data required. The Contractor shall develop and deliver a Software Assurance Plan as part of the Software Development and Management Plan (CDRL MO-9).

The Contractor shall classify all MOE software as belonging to one of the following criticality classifications and shall define the management approach of each class in the Software Management and Development Plan (SMDP) (CDRL MO-9):

(a) Mission Critical
(b) Mission Support
(c) Engineering Analysis
(d) Commercial

(d)1. Commercial software acquired for integral use within planned operational elements shall be assigned a criticality equal to that of the element of which it is a part.

These software classifications are defined in the LDCM Acronym List and Lexicon (GSFC 427-02-06).

The Contractor shall classify all MOE software as belonging to one of the following types of software and shall define the management approach of each class in the Software Development and Management Plan (SDMP):

(a) Developed
(b) Reuse
(c) Heritage
(d) Off-the-Shelf (OTS)

(d)1. OTS software is further defined as Commercial-Off-the-Shelf (COTS), Modified-Off-the-Shelf (MOTS) software, and Government-Off-the-Shelf (GOTS) software.

These software types are defined in the LDCM Acronym List and Lexicon (GSFC 427-02-06).

The Contractor shall meet the requirements of NASA Software Engineering Requirements specified in the NPR 7150.2 when choosing to use OTS software to satisfy all or part of the software requirements implementation. The details of OTS utilization and management of such shall be provided in the Contractor's SDMP.

The Contractor shall ensure that all software documentation and code required for the NASA Software Independent Verification and Validation (IV&V) effort is made available to NASA IV&V personnel. This includes access to all software reviews and reports, developer plans and procedures, software code, software design documentation, and software problem reporting data. Wherever possible, the Contractor shall permit electronic access to the required information or furnish soft copies of requested information to NASA IV&V personnel.

The Contractor shall review and assess all NASA IV&V findings and recommendations. The Contractor shall forward their assessment of these findings and recommendations to the LDCM Project Office. The Contractor shall take necessary corrective action based upon their assessment and notify the LDCM Project Office of this correction action. The Contractor shall also notify the LDCM Project Office of those instances where they decided not to take corrective action on specific IV&V findings and recommendations. A Contractor point of contact shall be assigned and available to NASA IV&V personnel, as required, for questions, clarification, and status meetings.

4 Mission Operations Element (MOE) Development

The Contractor shall develop, deliver, and install the MOE and the backup MOE in accordance with the Mission Operations Element Requirements Document (MOE-RD). All references to the MOE in this SOW apply equally to the back-up MOE. The Contractor shall provide all necessary personnel, facilities, services, and materials to develop, integrate, and test the MOE.

4.1 Design and Development

The Contractor shall design and develop the MOE, including requirements and interface analysis, which satisfies all the requirements of the MOE Requirements Document (MOE-RD). The Contractor shall deliver a MOE Design Specification and Description in accordance with CDRL MO-12.

The Contractor shall develop and deliver the MOE Operations Handbook in accordance with CDRL MO-8 and the MOE Operations Procedures in accordance with CDRL MO-11.

4.1.1 Telemetry, Command and Control

The Contractor shall develop the MOE Telemetry, Command and Control capabilities in accordance with the LDCM Mission Operations Element Requirements Document (GSFC 427-09-03).

The Government will establish and maintain the LDCM Project Database, which will combine spacecraft, instrument(s), and MOE command and telemetry databases in a common format. The Contractor shall provide inputs to the LDCM Project Database compliant with a government-provided Data Format Control Document and in accordance with CDRL MO-16. The Contractor shall accept and implement Government-provided deliveries/updates of the LDCM Project Database every 3 months beginning after integration of the spacecraft command and data handling system to the spacecraft bus. The Contractor shall also receive emergency updates or patches more frequently. The Government will verify any translations from MOE Contractor-provided database inputs to the LDCM Project Database.

4.1.2 IT and Communication Security

The Contractor shall comply with NPR 2810.1A, Security of Information Technology (IT) in development, integration, and testing of the MOE. The Government will review the Contractor's implementation of IT security requirements. The Contractor shall coordinate with the Government in the implementation of IT security requirements.

The Contractor shall comply with all communication security (COMSEC) requirements related to the development, integration, and testing of MOE command encryption and authentication

capabilities, compliant with the TBD. The Contractor shall develop and implement the capabilities to perform command encryption and authentication. The Contractor shall implement NSA-approved Caribou encryption and authentication in equipment/physical form. The Contractor shall utilize the MYK-15 device to perform encryption/authentication in the MOE. The contractor's COMSEC design shall comply with applicable contract clauses and applicable NSA requirements. NSA will supply the keying material for all COMSEC units. Delivery of keying material shall be contingent upon NSA approval of contractor handling and security plans (CDRL MO-XX).

The Contractor shall review and provide input to the LDCM Key Management Plan (CDRL MO-XX). The Contractor shall possess a COMSEC account, as issued by NSA, to support the development of command encryption and authentication capabilities. The Contractor shall have demonstrated experience in implementing NSA-certified command encryption/authentication equipment.

The Contractor shall participate in security indoctrination and a splinter meeting on the COMSEC implementation and certification process, both conducted by Government security representatives.

The contractor shall produce all documentation required by the NSA for the design, verification, certification, shipment, and flight of the COMSEC system, including the design and verification of any secure bypass system and the flight software which controls any COMSEC function.

Any deviations or waivers to the government security requirements or the National Security Agency's (NSA) requirements shall be approved by NASA prior to submission to the cognizant agency.

4.1.3 Planning and Scheduling

The Contractor shall develop the MOE Planning and Scheduling capabilities in accordance with the LDCM Mission Operations Element Requirements Document (GSFC 427-09-03).

4.1.4 Mission Monitoring and Analysis

The Contractor shall develop the MOE Mission Monitoring and Analysis capabilities in accordance with the LDCM Mission Operations Element Requirements Document (GSFC 427-09-03).

4.1.5 Flight Dynamics

The Contractor shall develop the MOE Flight Dynamics capabilities in accordance with the LDCM Mission Operations Element Requirements Document (GSFC 427-09-03).

4.1.6 Memory Management

The Contractor shall develop the MOE Memory Management capabilities in accordance with the LDCM Mission Operations Element Requirements Document (GSFC 427-09-03).

4.1.7 Automation

The Contractor shall develop the MOE Automation capabilities in accordance with the LDCM Mission Operations Element Requirements Document (GSFC 427-09-03).

4.2 Integrate and Test

The Contractor shall develop and deliver the following items in accordance with the stated CDRL:

a. MOE Test Plans, CDRL MO-4
b. MOE Test Procedures, CDRL MO-5
c. MOE Test Reports, CDRL MO-6

The Contractor shall allow Government personnel access to all MOE testing and test planning meetings, including Contractor-led Test Readiness Reviews.

The Contractor shall participate in informal interface testing between the MOE and other ground system elements during MOE development. Informal interface tests include the use of test data in the formats defined by MOE Interface Control Documents informally exchanged (e.g. by email or FTP site) between the MOE and other ground elements. The Contractor shall exercise test data provided by other ground elements, and shall provide MOE test data to ground elements.

Prior to each MOE delivery, the Contractor shall perform application acceptance testing to internally verify the MOE meets the requirements of the MOE-RD. Application acceptance testing is defined to be MOE standalone testing without the actual interfaces to the LDCM ground system elements, but using a method(s) to simulate the interfaces per the applicable ICDs. The Contractor shall allow Government personnel access to all MOE application acceptance testing data and result summaries at least 5 working days prior to each delivery release. Test result summaries shall be included in the delivery package.

4.3 Delivery Support

The Contractor shall provide multiple deliveries/releases of the MOE, with each delivery/release demonstrating increased functionality leading to the final MOE functionality as defined in the MOE-RD. The Contractor shall propose a MOE release schedule that supports the milestone capabilities shown in Table 4.3.1, at a minimum. The Contractor shall assume the milestone dates for planning purposes.

Table 4.3.1 MOE Delivery Capabilities

Milestone	Capability	Delivery Location
60 days after contract award	Contractor's Off-The-Shelf functionality prior to significant customization or addition of external interface capabilities (i.e. a stand alone capability); provide the Government with basic MOE functionality including but not limited to basic command and telemetry functions, to allow the Government FOT to become familiar with MOE software tools and use.	NASA/ GSFC and USGS/EROS
Beginning of spacecraft sub-system I&T – January 2009	Additional functionality developed by the Contractor since previous delivery, including but not limited to MOE command and telemetry functions and the interface to the bus developer's I&T ground system; capability to support command and telemetry processing with the spacecraft bus and instrument, validation of the initial Project Database, and FOT routine operations product development.	NASA/GSFC, USGS/EROS, Spacecraft vendor I&T facility, Instrument vendor D&T facility
Interim Delivery – Planning & Scheduling Support with open architecture – April 2009	Additional functionality developed by the Contractor since previous delivery, including but not limited to stored command management, capability to produce flight dynamics mission planning products, perform planning & scheduling activities to support development of FOT products and operations procedures, and initial open architecture capability.	NASA/GSFC
Ground System Integration / MOC Integration – July 2009	Complete MOE functionality including all interfaces and launch support room functionality; capability to support ground system integration, including integration of the MOE within the MOC and interface connectivity testing of MOE interfaces. This delivery shall support formal MOC installation and Ground System integration.	NASA/GSFC MOC
Ground System Readiness Testing – October 2009	Required updates/patches to previous delivery, as identified during ground system integration and interface connectivity testing, if any; capability to support Ground Readiness Tests (GRTs).	NASA/GSFC MOC, USGS/EROS bMOC
Mission	Required updates to previous delivery	NASA/GSFC MOC,

Readiness Testing – October 2010	identified as part of LDCM Ground Readiness Testing, if any; capability intended to support LDCM Mission Readiness Tests (MRTs).	USGS/EROS bMOC
Post-Mission Readiness Testing – March 2011	Required updates/patches to previous delivery identified as part of LDCM Mission Readiness Tests, if any.	NASA/GSFC MOC, USGS/EROS bMOC
Operations Readiness Review – May 2011	Represents required updates/patches to previous delivery needed to demonstrate LDCM Operations Readiness, if any.	NASA/GSFC MOC, USGS/EROS bMOC
Post-Launch – September 2011	Represents required updates/patches to previous delivery identified during the on-orbit check-out and commissioning of the LDCM observatory, if any.	NASA/GSFC MOC, USGS/EROS bMOC

The Contractor shall adhere to the approved MOE release schedule. The Contractor shall deliver, install, and configure all MOE releases at each of the facilities hosting a MOE system, as shown in Table 4.3.1. The Contractor shall test and verify that each MOE delivery/release is complete.

The Contractor shall train the Government on the installation and set-up procedures of the MOE at each facility. The Contractor shall develop and deliver MOE installation and test procedures in accordance with CDRL MO-7, so that Government can perform emergency patches/installations, regression testing, re-testing and re-installation, if needed.

Except for the Off-the-Shelf delivery, the Contractor shall provide the hardware required to operate the MOE at each of the facilities hosting a version of the MOE as the facility becomes available. If the Contractor's Off-the-Shelf delivery cannot be run on a standard commercial personal computer (s) or workstation(s), the Contractor shall identify the required hardware in their proposal.

With each MOE delivery, the Contractor shall provide MOE software or updated software. All MOE deliveries shall consist of the following items:

1) User's Manual in accordance with CDRL MO-15
2) Version Description Document (VDD) in accordance with CDRL MO-10 to include:
    a. Installation Instructions/Procedure in accordance with CDRL MO-7.
    b. Source Code (if provided)
    c. Executables
    d. Acceptance Test Results/Reports (CDRL MO-6)
    e. Matrix of requirements addressed by this release,
3) Delivery Letter identifying the versions of the User's Guide, VDD, Installation Instructions/Procedure, Source (if applicable), and Executables
4) Other documentation as appropriate

The Contractor shall provide technical helpdesk support during normal business hours via telephone beginning with the first MOE release delivery through final acceptance of the MOE.

5 Integration, Testing, and Operations Readiness

5.1 Integration and Testing

The Government is responsible for LDCM systems integration. The Contractor shall support Government systems integration and test activities. The Contractor shall verify that the MOE interfaces to the rest of the LDCM and meets the requirements of the MOE-RD. The Contractor shall provide support to Government systems integration activities, including providing representation to I&T and interface working groups.

The Contractor shall perform the following activities in support of the Government LDCM systems integration testing, including MOE and bMOE installation within the MOC and bMOC, MOE to spacecraft and observatory simulator I&T, LDCM Ground System Integration, Ground Readiness Testing, and Mission Readiness Testing:

a. Support development of test goals, requirements, and success criteria in coordination with the Government
b. Review and provide input to test procedures
c. Coordinate and allocate MOE test resources
d. Status all necessary MOE subsystem to insure subsystem test readiness and report all readiness issues to the Government
e. Participate in test readiness reviews (TRRs) approximately one week prior to the performance of each test that covers the test plan, procedures, scripts, and test support and coordination activities relevant to the MOE. Participate in delta TRRs, if needed.
f. Participate in testing and provide technical support to test conductors to execute the planned test procedures and generate data products
g. Collect, process, and document all MOE supporting data in a post test report
h. Resolve anomalies and incorporate lessons learned for future tests.
i. Provide network services from the Contractor facilities to Government facilities and to the bus vendor facilities for any MOE interface tests that occur prior to delivery to the MOC.

For planning purposes, the Contractor shall assume the following LDCM Integration and Test Milestone Schedule:

Event	**Start Date**
Start of MOE Command and Telemetry Tests with Spacecraft / Spacecraft Sub-system I&T	January 2009
MOC Integration / Ground System Integration	July 2009
Ground Readiness Testing	October 2009
Mission Readiness Testing	October 2010
Launch	July 2011

5.1.1 MOE-to-MOC Installation

The Contractor shall perform the installation/setup of the MOE in the Government MOC and the backup MOE in the backup MOC. The Contractor shall provide inputs to the Government MOC Facility Plan in accordance with CDRL MO-14, MOE Facility Integration Plan.

The contractor shall develop a MOC and bMOC integration plan and procedures in accordance with CDRL MO-14 and CDRL MO-7, respectively.

The Government will provide MOC and bMOC facility needs including power, network connectivity, and system administration support for the MOE-to-MOC and bMOE-to-bMOC installation.

5.1.2 Ground System and Mission Integration

The Contractor shall support MOE to LDCM spacecraft interface testing and MOE to LDCM observatory interface testing. This testing shall be performed incrementally, beginning with the delivery of MOE command and telemetry capability to the spacecraft vendor's I&T facility.

The Contractor shall provide connectivity between the MOE Contractor's facility and the LDCM operational network.

The Contractor shall provide on-site support at the spacecraft contractor's facility for all MOE formal tests run against the LDCM spacecraft/observatory.

The Contractor shall support MOE to LDCM observatory simulator interface testing to verify the capability of the MOE to communicate with the observatory simulator and to exercise the functional performance of all MOE subsystems. MOE to observatory simulator interface testing shall occur at the MOC.

The Government flight operations team representatives will serve as test conductors for both the spacecraft and observatory simulator interface tests.

The Contractor shall participate in MOE and backup MOE to LDCM Ground System integration and interface connectivity testing. Ground System Integration will include the establishment of network connectivity between the MOE and other ground system elements. This will include tests between the MOE and all of the LDCM Ground System Elements to demonstrate network connectivity and data flow. Integration and interface connectivity testing shall be performed from the MOC (and the bMOC). The Government will provide network connectivity between the MOE/bMOE and all other Ground System Elements.

The Contractor shall participate in LDCM Ground Readiness Testing to verify the functional requirements of the integrated LDCM Ground System. The Contractor shall be available to support these activities from the MOC, as needed. The Contractor shall provide on-site support for any MOE-related GRTs run against the LDCM spacecraft/observatory. The Government flight operations team representatives will serve as MOE test conductors for the Ground Readiness Tests in the MOC.

The Contractor shall participate in LDCM Mission Readiness Testing to verify the performance requirements of the integrated LDCM space segment and ground system. The Contractor shall support these activities from the MOC, as needed. The Contractor shall provide on-site support for any MOE-related MRTs run against the LDCM spacecraft/observatory. The Government flight operations team representatives will serve as MOE test conductors for Mission Readiness Tests.

5.2 Operations Readiness

The Contractor shall participate in Mission Operations Readiness to include operator training, readiness exercises, and launch rehearsals. The Contractor shall support these activities from the MOC.

5.2.1 Flight Operations Team Training

The Contractor shall develop a MOE Flight Operations Team Training Plan in accordance with CDRL MO-13. The Contractor shall conduct two 3-day sessions to train the Government Flight Operations Team on the operation of the MOE. The first 3-day session shall be conducted with the first delivery of a MOE capability to a Government facility. The Contractor shall train up to 20 Flight Operations Team members at the first 3-day session. The second 3-day session shall be conducted following the installation/setup of the MOL in the MOC facility. The Contractor shall train up to twenty Flight Operations Team participants.

The Contractor shall conduct additional 1-day training session of Flight Operations Team members with each MOE updated release delivery. The Contractor shall train up to 20 Flight Operations Team members at each 1-day session.

For each training session the contractor shall prepare and provide all course materials including the MOE Operations Handbook (MO-8).

5.2.2 Mission Simulations and Launch Rehearsals

The Contractor shall participate in a minimum of five (5) mission simulation exercises with the Government provided Flight Operations Team to simulate typical day-in-the-life on-orbit observatory operations. The exercises will simulate day-in-the-life scenarios that include exercise of nominal command and control operations, mission scheduling, state-of-health (SOH) monitoring procedures, and anomaly recovery operations.

The Contractor shall participate in a minimum of three (3) launch rehearsals. The third Launch Rehearsal is a “full dress rehearsal” and includes participation by all LDCM Space, Ground, and Flight Operations segment personnel and resources required to conduct launch and early orbit (L&EO) activities. The launch rehearsals will demonstrate nominal execution of timelines as well as simulated anomaly/contingency response scenarios. The Contractor shall support the FOT in planning and executing any MOE related anomalies. Government flight operations team representatives will serve as test conductors for launch rehearsals.

For these mission simulation exercises and launch rehearsals, the Contractor shall participate in:

- Devising the goals and resource requirements
- Reviews of planned activity with participants
- Executing the activity and collecting appropriate data
- Post-activity debriefs and lessons learned review with participants
- Generating a post activity report that documents the outcome of rehearsal activities.
- Resolving anomalies and incorporating lessons learned into future activities

Mission simulations and launch rehearsals will take place in the MOC.

6 Early Orbit Operations and Acceptance

6.1 MOE Early Operations Support

The Contractor shall provide MOE personnel at the MOC on a round-the-clock basis from 24 hours prior to launch through the completion of early orbit time critical operations of the LDCM observatory, nominally 7 days following launch. The Contractor shall provide on call support for any MOE operational problems or anomalies through MOE final acceptance.

6.2 Handover and Acceptance

The Government will provisionally accept the MOE following the verification of all requirements, successful completion of all MOE testing, and successful completion of the LDCM Operations Readiness Review.

The Contractor shall participate in and support the MOE portion of the LDCM On-Orbit Acceptance Review prior to Government final acceptance of the MOE in accordance with CDRL RE-6. The Contractor shall deliver an Acceptance Data Package in accordance with CDRL SE-23.

Final acceptance of the MOE will occur following successful verification of the post-launch MOE release as defined in Section 4.3 and the Contractor's successful completion of the On-Orbit Acceptance Review.

7 Post-Acceptance Support

7.1 Nominal Support

The Contractor shall provide the following services after Government acceptance through the period of performance of the contract:

1. Maintain the MOE and MOE documentation.
2. Maintain any unique MOE software development tools
3. Maintain all COTS licenses, maintenance fees and upgrades
4. Prior to the end of the contract period, train the Government and Government-defined contractor support staff on maintenance of MOE software in preparation for transition of MOE software maintenance to the Government, including in the use and maintenance of any unique MOE software development tools environments.
5. Prior to the end of the contract period, deliver to, install in, and check out the performance of any unique MOE software development tools/environments in the Government MOC facility.

In this context, "maintain" means: keep the operational system operating, replace software and hardware to meet MOE availability requirements, perform configuration control and configuration management documentation.

7.2 Task-Based Support

The Contractor shall perform tasks relating to the continued operational support of the LDCM MOE, as authorized by the Government and in accordance with the Contract. Each task will be initiated by written direction from the Government contracting officer. The Government will coordinate with the Contractor to define each task in detail, and establish manpower ceilings, performance schedules, and deliverables.

These Government-initiated tasks will include the following:

1. Provide a MOE hardware refresh at the direction of the Government, but no sooner than two years after acceptance.
2. Support MOE operations as required. This support shall include but is not limited to supplying technical expertise to perform analyses, to review data, or to review changes to documentation.
3. Investigate anomalies of the Mission Operations Element and provide recommendations for resolution.
    a. For non-critical anomalies, the Contractor shall acknowledge notification of the anomaly and provide an initial action plan within 48 hours of notification by the Government. A non-critical anomaly is one where degradation or failure does not

impair mission performance in a manner that could jeopardize the health and safety of the LDCM observatory.

b. For critical anomalies, the Contractor shall acknowledge notification of the anomaly and provide an initial action plan within 8 hours of notification by the Government. A critical anomaly is one where degradation or failure could jeopardize the health and safety of the LDCM observatory.

4. Provide updates to MOE software to provide capabilities requested by the Government, including technical documentation, installation procedures, validation procedures and back-out procedures.
5. Support the transition of the primary MOC from NASA GSFC in Greenbelt, MD to the USGS Center for EROS in Sioux Falls, SD.
6. Support the transition of the backup MOC from the USGS Center for EROS in Sioux Falls, SD to a TBD location.

8 Optional Extended Support

If the Government exercises the optional one-year extensions of on-orbit support in accordance with the Contract, the Contractor shall perform the following during the option period.

8.1 Nominal Support

The Contractor shall provide the following services after Government acceptance through the period of performance of the contract:

1. Maintain the MOE and MOE documentation.
2. Maintain any unique MOE software development tools
3. Maintain all COTS licenses, maintenance fees and upgrades
4. Prior to the end of the contract period, train the Government on maintenance of MOE software in preparation for transition of MOE software maintenance to the Government, including in the use and maintenance of any unique MOE software development tools environments.
5. Prior to the end of the contract period, deliver to, install in, and check out the performance of any unique MOE software development tools/environments in the Government MOC facility.

In this context, "maintain" means: keep the operational system operating, replace software and hardware to meet MOE availability requirements, perform configuration control and configuration management documentation.

8.2 Task-Based Support

The Contractor shall perform tasks relating to the continued operational support of the LDCM MOE, as authorized by the Government and in accordance with the Contract. Each task will be initiated by written direction from the Government contracting officer. The Government will

coordinate with the Contractor to define each task in detail, and establish manpower ceilings, performance schedules, and deliverables.

These Government-initiated tasks will include the following:

1. Provide a MOE hardware refresh at the direction of the Government, but no sooner than two years after acceptance.
2. Support MOE operations as required. This support shall include but is not limited to supplying technical expertise to perform analyses, to review data, or to review changes to documentation.
3. Investigate anomalies of the Mission Operations Element and provide recommendations for resolution.
    a. For non-critical anomalies, the Contractor shall acknowledge notification of the anomaly and provide an initial action plan within 48 hours of notification by the Government. A non-critical anomaly is one where degradation or failure does not impair mission performance in a manner that could jeopardize the health and safety of the LDCM observatory.
    b. For critical anomalies, the Contractor shall acknowledge notification of the anomaly and provide an initial action plan within 8 hours of notification by the Government. A critical anomaly is one where degradation or failure could jeopardize the health and safety of the LDCM observatory.
4. Provide updates to MOE software to provide capabilities requested by the Government, including technical documentation, installation procedures, validation procedures and back-out procedure.